BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

As rescanning documents *will not* correct images, please do not report the images to the Image Problem Mailbox.

(12) UK Patent Application (19) GB (11) 2 351 634 (13) A

(43) Date of A Publication 03.01.2001

(21) Application No 9914934.6

(22) Date of Filing 26.06.1999

(51) INT CL[7]
G10K 15/02

(52) UK CL (Edition S)
H4R RPX
G5J JEMX J2A
U1S S1843

(56) Documents Cited
GB 2261103 A GB 2254979 A WO 92/08225 A1
WO 91/18385 A1 WO 90/13109 A1 US 5237617 A

(58) Field of Search
UK CL (Edition Q) G5J JEBA JEMX , H4J JGA , H4R RPX RSX
INT CL[6] G10K
Online: WPI, JAPIO, EPODOC

(71) Applicant(s)
Thomas Brendan Francis Clarke
Oak Cottage, The Triangle, Wrington,
North Somerset, BS40 5LB, United Kingdom

(72) Inventor(s)
Thomas Brendan Francis Clarke

(74) Agent and/or Address for Service
Carol Greaves
C.P. Greaves & Co, 24A Woodborough Road,
Winscombe, North Somerset, BS25 1AD,
United Kingdom

(54) Abstract Title
Audio processing system

(57) An audio processing system has particular application in passenger vehicles. In a preferred embodiment, the system comprises a vehicle audio installation comprising audio reproduction apparatus including an amplifier (14) and one or more transducers (16) for radiating sound into a passenger compartment of a vehicle. The audio installation may be a system for reproducing audio recordings. The system further includes a signal generation stage (10) having a synchronising signal input (20) and an audio signal output (12). The signal generation stage is operable to generate an audio frequency signal on its output (12). These signals are generated at a rate determined by a periodic synchronisation signal appearing on its input (20), which synchronisation signal varies with the speed of operation of the engine of the vehicle. The audio signal output being connected to supply signals to the amplifier (14) for reproduction by the audio reproduction apparatus. A memory device, such as a chip card, (30) contains data which can be interpreted by the signal generation stage to determine the perceived sound to be generated by the output stage. The system can operate to enhance the perceived sound of a vehicle during operation.

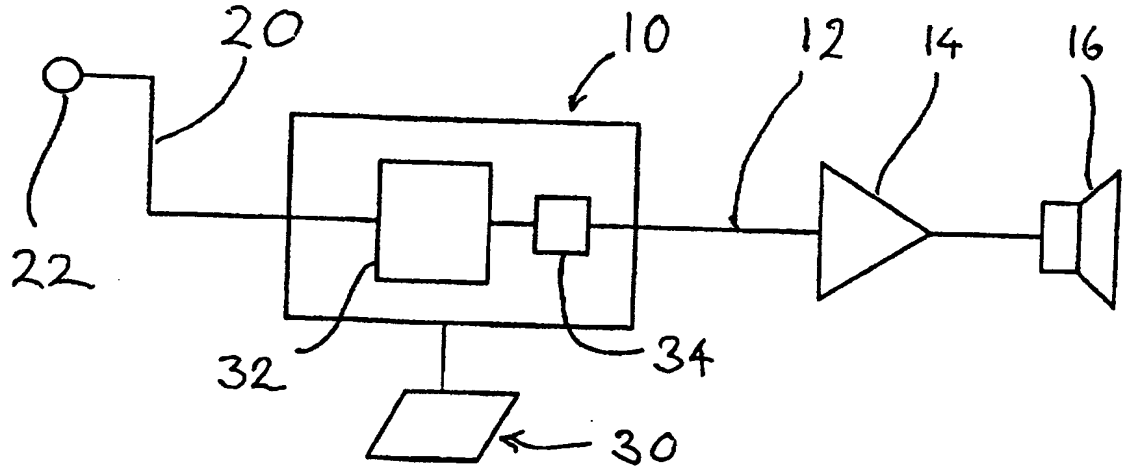

Fig 3

GB 2 351 634 A

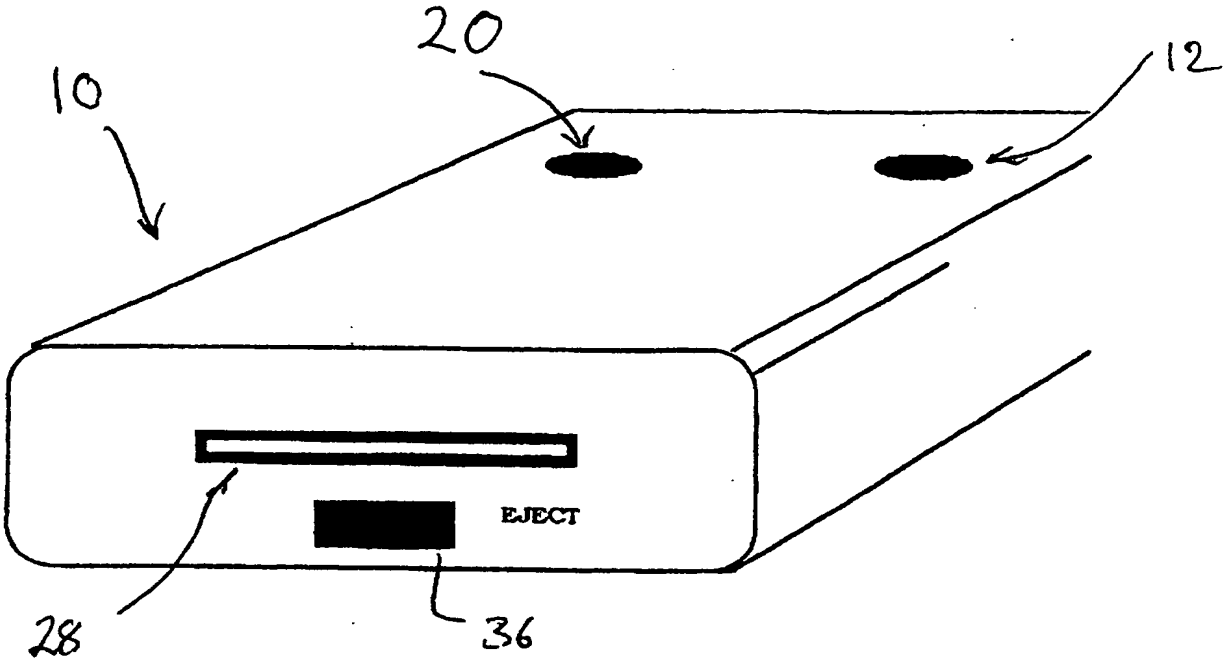

Fig 1

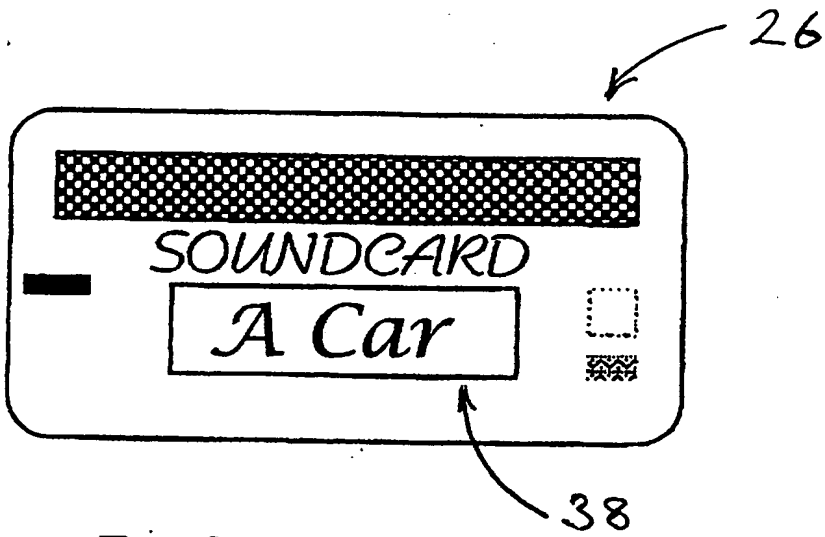

Fig 2

Audio Processing System

The present invention relates to an audio processing system. Preferred embodiments of the invention have particular but not exclusive suitability for use in a motor vehicle.

Most vehicle manufacturers strive to minimise the level of noise experienced by the occupants of a vehicle. However, the sound of a vehicle engine can, in some circumstances, be a positive experience for an occupant of the vehicle. This is most particularly so in cases where the vehicle has a high-powered engine. This is exploited by some specialist vehicle manufacturers, most notably of sports cars, where the vehicle is designed to emphasise the quality of the sound that the vehicle produces. This relies upon exploitation of particular characteristics of sports car engines which are not present in other vehicles. Moreover, in other vehicles, more typically optimised for comfort rather than performance, such noise can, for much of the time, be intrusive.

It is known to reduce perceived noise within a vehicle using techniques of active noise cancellation. Such techniques inject sound radiation into the passenger compartment of a vehicle. The sound radiation is chosen to have a waveform that is approximately in anti-phase with the typical noise within the vehicle. This gives rise to destructive interference, whereby the total sound energy within the passenger compartment is reduced. A further development of these techniques employ selective destructive interference and/or addition of other sound components, with the object that the sound that remains after cancellation is of a quality that is of a better aural quality than the natural sound of the vehicle.

Hitherto, systems which implement active noise cancellation have been designed to be integrated into a vehicle upon manufacture. Each system is designed to operate in just one particular model of vehicle. As such, they are expensive, and are not available to users of existing vehicles. Indeed, there have been few applications of such systems in vehicles to date.

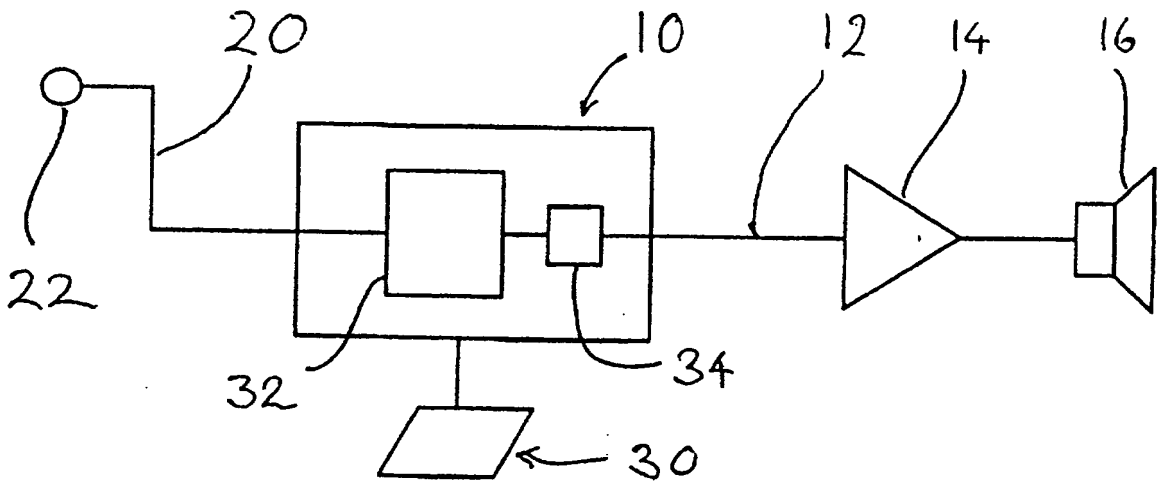

Fig 3

An aim of the invention is to provide an audio processing system for enhancing the sounds of apparatus such as a vehicle, which is of relatively low cost and which can be readily installed. It is an additional aim of the invention to provide an audio processing system which principally operates to modify the perceived quality of sound within a vehicle.

From a first aspect, the invention provides an audio processing system comprising:

a signal generation stage having a synchronising signal input and an audio signal output, the signal generation stage being operable to generate an audio frequency signal on its output, these signals being generated at a rate determined by a periodic synchronisation signal appearing on its input;

an output stage operative to convert the audio frequency signal to audible sound;

a memory device containing data which can be interpreted by the signal generation stage to determine the perceived sound generated by the output stage.

This arrangement permits the sound generated to be altered readily by changing the contents of the memory device.

In an audio signal processing system embodying the invention, the output stage may include components of a vehicle audio reproduction system. In particular, the output stage may include an amplifier and one or more transducers (typically, loudspeakers) of a vehicle audio reproduction system. Since many vehicles are equipped with an audio system, this arrangement simplifies the procedure for and reduces the cost of implementing the system in a vehicle.

For implementation in a vehicle, the periodic signal is most typically indicative of the rate of operation of an engine of the vehicle. This allows the sound produced by the system to change and the speed of the engine changes. In a spark ignition engine, the signal may be derived from the engine's ignition system.

Conveniently, the signal generation stage may be incorporated into a unit adapted for mounting in a vehicle. Moreover, the memory device may be incorporated into a module adapted for removable interconnection with the unit. This permits a user to change the sound produced by the system by selection of a suitably programmed module. In a preferred embodiment, the memory device is embodied in a chip card.

A system embodying the invention typically further includes a transducer for generating synchronisation signals at a frequency proportional to the frequency of operation of an external piece of apparatus. In many embodiments, the external piece of apparatus is a vehicle engine. Where such an engine is a spark ignition engine, the transducer may conveniently be is coupled (most preferably, inductively coupled) to part of an ignition system of the vehicle. Alternatively, the transducer may detect motion of a part of the engine.

In alternative embodiments, synchronisation signals are derived from an engine management system of a vehicle engine.

Typically, the memory device contains data representing sounds sampled from a piece of apparatus.

From another aspect, the invention provides a vehicle audio installation comprising:

audio reproduction apparatus including an amplifier and one or more transducers for radiating sound into a passenger compartment of a vehicle;

a signal generation stage having a synchronising signal input and an audio signal output, the signal generation stage being operable to generate an audio frequency signal on its output, these signals being generated at a rate determined by a periodic synchronisation signal appearing on its input, which signal varies with the speed of operation of the engine of the vehicle and, the audio signal output being connected to supply signals to the amplifier for reproduction by the audio reproduction apparatus;

a memory device containing data which can be interpreted by the signal generation stage to determine the perceived sound to be generated by the output stage.

Most usually, the memory device contains digital representation of sounds experienced within a vehicle of a type other than that in which the installation is present. An interchangeable chip card can suitable serve as a memory device.

An embodiment of the invention will now be described in detail, by way of example, and with reference to the accompanying drawings, in which:

Figure 1 shows a unit for mounting in a vehicle, the unit being a component of a system embodying the invention;

Figure 2 shows a chip card for use with the unit of Figure 1; and

Figure 3 is a block diagram of a system embodying the invention.

With reference to the figures, there will be described a system embodying the invention for use in a passenger vehicle. In this embodiment, the system includes a self-contained unit 10 suitable for mounting within the passenger compartment of the vehicle. The unit 10 is connected to the vehicle's power supply by conventional connectors (not shown).

The unit 10 has an audio output line 12. The audio output 12 is connected to the input of an audio amplifier 14, the output of which drives a plurality of loudspeakers 16 disposed within the passenger compartment. The audio amplifier 14 and the loudspeakers 16 can conveniently be components of an audio reproduction system of the vehicle, in which case signals appearing on the audio output will typically be at audio line level. Alternatively, if such components are not available or are unsuitable, an amplifier and/or speakers may be provided specifically for use with the system.

In addition, the unit 10 has a synchronising input line 20. The synchronising input line 20 conveys signals from a transducer 22 to the unit 10. The transducer 22 generates pulse signals at a frequency which is proportional to the speed of operation of the vehicle's engine. In the case of spark-ignition engines, the transducer 22 may, most conveniently, be coupled inductively to part of the ignition system. For example, the transducer may comprise a coil secured to a high-tension lead or a low-tension lead of

the ignition system. Alternatively, the transducer may detect rotation of a component of the engine directly (most convenient for compression-ignition engines, where a suitable electrical system may not be available). For example, an optical switch may be used to detect passage of a projection mounted on a crank pulley.

The unit 10 further includes a chip card reader 28 which may be of substantially conventional construction. A chip card 26 is provided for use in combination with the unit 10. Contained within the chip card 26 is a read-only memory module 30, the contents of which can be accessed by the card reader 28.

Operation of the unit 10 is controlled by a digital control stage 32. An output of the control stage 32 is conveyed to a digital to analogue converter stage 34 which, in turn, generates the audio output signal of the unit 10.

The data contained within the memory module 30 typically includes digitised samples of sounds recorded from a specific vehicle. For example, the sounds may be of a multi-cylinder sports car engine. The sounds may be sampled at a variety of engine speeds and operating conditions from idle to full power and maximum operating speed.

In operation, the unit 10 is inactive until the vehicle engine is started. Once the engine is started, the unit receives signals on its synchronising input line 20. If the control stage 32 detects a card 26 in the card reader 28, the control stage then starts to generate digital signals which are conveyed to the digital to analogue converter 34 for amplification and reproduction as sound by the loudspeakers 16 within the passenger compartment of the vehicle.

The form of the signals generated by the control stage 32 is varied in dependence upon the frequency and rate of change of frequency of signals appearing on the synchronising input line 20.

As an example, the memory module may contain sound samples taken at increments of 100 rpm of engine speed between idle and maximum speed. At each

speed, separate samples are taken, corresponding to high-load, part-load and no-load conditions of engine operation.

In use, the control stage 32 calculates an instantaneous engine speed from the frequency of synchronising signals. The instantaneous speed is then used by the control stage 32 to select a sample taken at a speed most close to the instantaneous speed. Any discrepancy between the sampled speed and the actual speed may be compensated by adjusting the pitch and tempo of the sample accordingly. If the engine speed is increasing, the frequency of the synchronising signals will also be increasing. If the rate of increase is beyond a threshold, the control stage 32 selects the sample taken at high load. On the other hand, if the engine speed is decreasing at a rate greater than a threshold, the control stage 32 selects the sample taken at no load. In other conditions, the part-load sample is selected.

By carrying out these relatively simple processing steps, the sounds produced by the system will vary in a manner consistent with changes in the operation of the vehicle. The system can therefore give an impression that the sounds it is producing are actually being produced by the vehicle.

As has been described, the sampled sounds from which the system generates its output are stored on a chip card 26. The card 26 may contain sounds recorded in a particular vehicle, and be labelled accordingly as shown at 38. For variety, or personal preference, the chip card 26 can be removed by operation of a user control 36. The card 26 may readily be replaced with another which contains samples of sounds from another vehicle. Indeed, for novelty value, the sound samples contained on the card may be samples of sounds produced by an object other than a vehicle. Alternatively, the card need not be replaced whereupon the unit 10 is deactivated.

The embodiment described above requires few connections into the electrical system of a vehicle. It is therefore simple to install and can be provided in kit form for installation in an existing vehicle at low cost. It will be apparent that the realism of the sounds that the system produces might be improved by providing additional signal

inputs and additional signal processing. For example, the system might monitor the position of the throttle of a spark ignition engine or the fuel rack of a compression ignition engine, and modify its output accordingly.

Claims

1. An audio processing system comprising:

a signal generation stage having a synchronising signal input and an audio signal output, the signal generation stage being operable to generate an audio frequency signal on its output, these signals being generated at a rate determined by a periodic synchronisation signal appearing on its input;

an output stage operative to convert the audio frequency signal to audible sound;

a memory device containing data which can be interpreted by the signal generation stage to determine the perceived sound to be generated by the output stage.

2. An audio signal processing system according to claim 1 in which the output stage includes components of a vehicle audio reproduction system.

3. An audio signal processing system according to claim 2 in which the output stage includes an amplifier and one or more transducers of a vehicle audio reproduction system.

4. An audio signal processing system according to any preceding claim in which the periodic signal is indicative of the rate of operation of a vehicle engine.

5. An audio signal processing system in which the signal generation stage is incorporated into a unit adapted for mounting in a vehicle.

6. An audio signal processing system according to claim 5 in which the memory device is incorporated into a module adapted for removable interconnection with the unit.

7. An audio signal processing system according to claim 6 in which the memory device is embodied in a chip card.

8. An audio signal processing system according to any preceding claim further comprising a transducer for generating synchronisation signals at a frequency proportional to the frequency of operation of an external piece of apparatus.

9. An audio signal processing system according to claim 8 in which the external piece of apparatus is a vehicle engine.

10. An audio signal processing system according to claim 9 in which the transducer is coupled to part of an ignition system of the vehicle.

11. An audio signal processing system according to claim 10 in which the transducer is inductively coupled to part of an ignition system of the vehicle.

12. An audio signal processing system according to claim 9 in which the transducer detects motion of a part of the vehicle engine.

13. An audio signal processing system according to any one of claims 1 to 7 in which the synchronising signals are derived form an engine management system of a vehicle engine.

14. An audio signal processing device according to any preceding claim in which the memory device contains data representing sounds sampled from a piece of apparatus.

15. An audio signal processing system substantially as herein described with reference to the accompanying drawings.

16. A vehicle audio installation comprising:

audio reproduction apparatus including an amplifier and one or more transducers for radiating sound into a passenger compartment of a vehicle;

a signal generation stage having a synchronising signal input and an audio signal output, the signal generation stage being operable to generate an audio frequency signal on its output, these signals being generated at a rate determined by a periodic

synchronisation signal appearing on its input, which synchronisation signal varies with the speed of operation of the engine of the vehicle and, the audio signal output being connected to supply signals to the amplifier for reproduction by the audio reproduction apparatus;

a memory device containing data which can be interpreted by the signal generation stage to determine the perceived sound to be generated by the output stage.

17. A vehicle audio installation according to claim 16 in which the memory device contains digital representation of sounds experienced within a vehicle of a type other than that in which the installation is present.

18. A vehicle audio installation according to claim 16 or claim 17 in which the memory device is incorporated into an interchangeable chip card.

19. A vehicle audio installation according to any one of claims 16 to 18 in which the audio reproduction apparatus is capable of reproducing audio recordings carried on media such as magnetic tape or optical disc.

20. A vehicle audio installation substantially as herein described with reference to the accompanying drawings.

The Patent Office

INVESTOR IN PEOPLE

Application No:	GB 9914934.6	**Examiner:**	Mr.Sat Satkurunath
Claims searched:	ALL	**Date of search:**	1 September 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): H4R: RPX, RSX; H4J: JGA; G5J: JEBA, JEMX

Int Cl (Ed.6): G10K

Other: Online: WPI, JAPIO, EPODOC

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB2261103A	KHAZEN et al - see especially the abstract and figures 1 and 6	1-5,8-12, 16, 17, 19
X	GB2254979 A	ROVER - see especially the figure	1, 4, 5, 8-10, 16
X	WO 92/08225 A1	LOTUS - see especially figures 1, 2	1-5,8-10, 16, 17
X	WO 91/18385 A1	HENNL - see especially the abstract and the figure	1, 4, 5, 8-10, 16
X	WO 90/13109 A1	LOTUS - see especially the figure	1-5, 8-10, 16, 17
X	US 5237617	MILLER - see especially figure 1 and lines 8-27 in column 4	1-10,16. 17

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.